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THE EFFECTS OF MAGNETIC STORM PHASES ON F-LAYER IRREGULARITIES FROM AURORAL TO EQUATORIAL LATITUDES

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EQUATORIAL AND MIDDLE LATITUDE STUDIES

During this quarter there was the start of an extensive review of the literature on middle latitude irregularities. In earlier reports we have noted the levels of irregularities at latitudes above the equatorial anomaly region (within 15 degrees of the magnetic equator) thru our analysis of a few examples of raw data from Osan, Korea. We then began to reduce and analyze data from Puerto Rico and Hawaii using 136 MHz scintillation data taken during both high and low solar flux years. At the levels that can be noted (peak to peak excursions of 15-20 dB) there is considerable activity.

In order to place the data into proper perspective a review of published observations in the literature was started. This is a considerable task since much of the raw data is published in a host of publications which include symposia relevant to ionospheric matters (AGARD, URSI, Satellite Beacon Meetings) without the data getting into the periodical literature. The data base if fully examined would include observations made along an Australian chain, thru Japan and Korea. It would include the chain of stations along the 70 degree West meridian. Observations which should be studied include scintillation, ground and satellite ionosonde observations as well as in situ measurements (OGO 6, DE-2 etc.). At the present we are concentrating on the reduction of a set of data in our hands.

The interest in middle latitude irregularities includes such diverse users as Low Orbiting Satellites (to be instrumented at 136-150 MHz), called Little LEOs, OTH radars and their clutter problems, and heating experiments at Arecibo Puerto Rico and in Alaska. From the point of view of trying to understand the physical mechanisms involved little has been studied. Even the morphology and the necessary conditions for the generation of middle latitude irregularities has only been the subject of a few research studies. There has been little done understanding the coupling of E and F layer irregularities. We are proposing that the continuation of our work on irregularities from equatorial to high latitudes concentrate a major portion of its study on middle latitude irregularities.

During the month of December we prepared a paper for the January meeting of URSI. This paper originally was concerned with irregularities along a longitudinal chain in the Pacific from latitudes close to the magnetic equator to the equatorial anomaly. The abstract was given in our last quarterly report. The data turned out to be puzzling but consistent for the most part with the concept that the high altitude equator plumes map along the lines of force of the earth's field and generate irregularities at latitudes up to and including the anomaly region. However the study raised more questions than it answered.

For latitudes somewhat higher that the anomaly region, the problem arises of separating polewards effects of the equatorial plumes and the equatorwards motion of irregularity development originating in the auroral region during severe magnetic storms. In addition to the equatorward development of high latitude storms and polewards development of the high altitude plume irregularities, a possibility exists for the generation of another class of F-layer irregularities at mid-latitudes. There exists a body of data from Japan, Port Moresby, Osan, and Palehua, Hawaii in the Pacific region as well as data along the 60-75 degrees West meridian.

As we stated in our last quarterly report recent OTH observations made both in the U.S. and in Australia found that F-layer ionospheric irregularities in the southern equatorial anomaly latitudes and probably beyond that were producing clutter

on OTH units located in Northern states in the U.S. In the recent URSI Meeting in January 1994, Dr. Gary Sales of the University of Massachusetts at Lowell indicated that the F layer irregularities observed by the OTH radar in New England came most probably from latitudes south of the southern equatorial anomaly. Irregularities even at mid-latitudes can be an important part of the clutter which serious degrades OTH observations.

In the last quarter, both Dr. Mendillo and Dr. Aarons worked up data from the Brazilian optical observations reported in earlier reports. The studies on magnetically quiet periods in the paper (accepted by the *Journal of Atmospheric and Terrestrial Physics*) were expanded during this quarter to include a study of magnetic storm periods. The abstract for the paper on storm time irregularities is given below; it is expected that it will be included in a COSPAR volume.

STUDIES OF STORM-TIME EQUATORIAL F-REGION IRREGULARITIES

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ABSTRACT

Observations of the F-region nightglow emissions from recombination processes can be used to remotely observe the dynamics of the plume type of equatorial ionospheric irregularities. Using a large data-base (1987-1991), the OI 630 nm emission wide-angle imaging observations taken in the equatorial anomaly region of the Brazilian sector at times yielded effects of equatorial plumes at altitudes equal to and greater than 2500 km. The occurrence of these high altitude equatorial ionospheric irregularities was noted during years of high and low solar flux; the results have been presented by Sahai et al. (1993).

In this study we present case studies of the generation or absence of depletion regions only during the months when the occurrence of F-layer irregularities is at its minimum (for Brazil during the months of June, July and August. We use the data base of the OI 630 nm emission imaging and ionospheric sounding observations in Brazil. The cases studied occurred in years of both high and low solar flux.

As expected during the months stated, depletions were not detected during the 20 nights when Kp was less than 4. In the 18 nights when Kp was 4 or greater, depletions were generated overhead on 3 nights. Given these data the necessary conditions at the equator for the generation of plumes have to include neutral winds, height and electron density of the F2 layer before the onset of the storm. In addition the dynamics of the individual storms have to be viewed (i.e. the time of maximum ring current flux, the form of the storm, and the intensity of the magnetic storm parameters).

AASERT PROGRAM IN UPPER ATMOSPHERE AND IONOSPHERIC PHYSICS

Ms. Colerico has been working with current data analysis tools as well as writing new utilities to facilitate in the study of equatorial plasma depletions. She has been involved with the study of observations made at Wake Island in August 1990, mapping 6300 A airglow data to the corresponding ALTAIR radar data. Ms. Colerico is also involved with the fabrication of an all-sky imager which will be installed at Millstone Hill. The imager is currently being assembled with testing to follow shortly afterward.

THE ONR SPONSORED ALL-SKY IMAGER

The fabrication of an all-sky imager for installation at Goose Bay is complete. Several months of testing at a field site have shown that the instrument is functioning as designed. It is now ready for installation at Goose Bay. When weather permits, the equipment will be installed by Boston University personnel and tested at Goose Bay.